An automated typesetting system

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The photocomposer

Since the Linotron high-speed photocomposer is the heart of the Linotron system, certain features of this equipment will be described first. The Linotron produces typeset matter under the control of a properly programmed magnetic tape. Characters are generated electronically as called for by the input magnetic tape, displayed in their correct page positions on a cathode ray tube, and photographed on to film or paper output. The positioning of the characters is also under the control of the input magnetic tape. Since there is no film advance until after the entire page has been set, the variety of page designs that can be produced is in no way limited by the hardware.

Characters are stored on glass character grids. Each grid consists of 255 clear negative images of desired symbols and one test symbol set in a 16 x 16 array. Up to four grids may be mounted in the machine at one time, and character grids are easily changed, no adjustment or realignment of the photocomposer being required. Width information for each character is also stored on the character grid. Any of the four grids can be positioned in the generator by command from the control tape. These grid changes, being mechanical in nature, require one half-second; the characters contained on the grid in position, however, can be selected at electronic speeds.

Each character in the grid complement can be set at any one of eight different sizes ranging from five to 18 pts. Point size change is also accomplished at electronic speeds. Although the Linotron can set a given character at a specified point size in any X-Y co-ordinate position on the page, it is basically a slave machine. With the exception of character widths, there are no formatting data or logic circuits. The input tape must contain all selection and positioning codes for the data characters to be typeset.

The system

It is the function of the Linotron system to take, as input, the raw data to be typeset and to produce, as output, the completely madeup page formatted in accordance with the page-design specifications selected. Data are introduced into the system (Fig 1) on an input magnetic tape. This tape can carry items that have been obtained from earlier computer processing, or it can carry items that have been specifically keyboarded from manuscript. It contains, in coded form, all the data characters, but it carries no codes that would specify typographic format. Instead, reference codes are inserted in the data. These codes refer to the type-style, line length, and other typographic specifications that have been stored in a computer programmed with the master typography program. These typographic specifications are first placed on parameter cards, which are prepared for each new format, and then are placed on a parameter tape via a parameter maintenance computer program that has been written to facilitate the updating of the parameter tape.

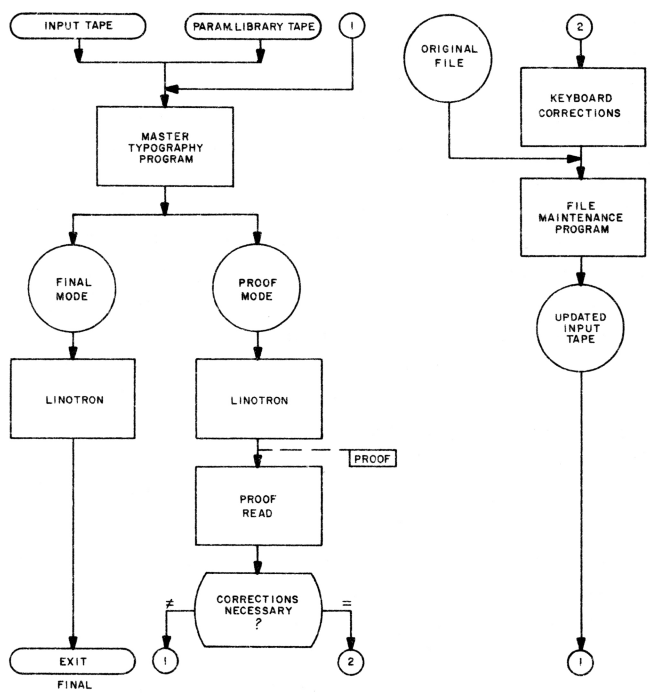

Fig 1 Linotron system

As shown in Fig 1, the parameter library tape is also an input to the master typography program. When reference codes on the input tape call for a specific format, the master typography program causes the data in the parameter tape for the specified format to be read into core storage. Once the parameters are in core, the master typography proceeds to process the data on the input tape in accordance with the typographic specifications contained in the parameter area. The program can be operated in either the proof or the final mode. If the input tape is known to be error free, the master typography program is operated in the final mode. If the output tape that is produced is used as input to Linotron, the photocomposer will produce completely typeset pages properly made up with space left for illustrations. Output will be on photographic film or paper. If the input tapes are not known to be error free, the master typography program is operated in the proof mode. The output of the system in this mode is single column proof that meets the following four

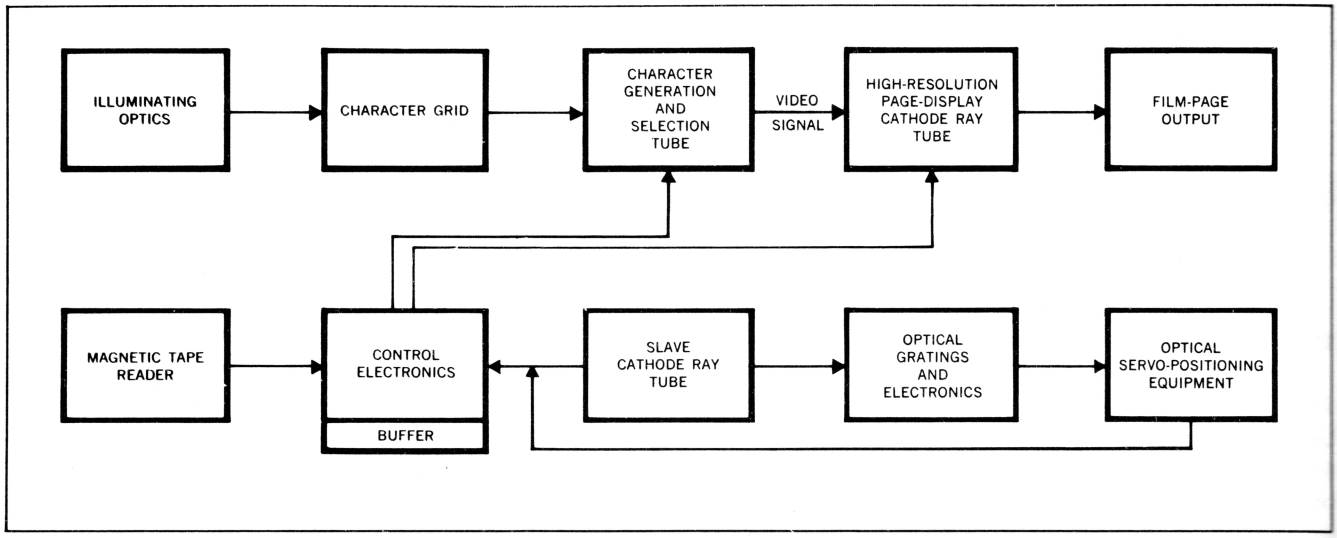

Fig 2 Block diagram of the Linotron

conditions: 1 Start of column positions are clearly indicated. 2 Space is left for illustrations. 3 All matter is set as it will appear in final copy. 4 An eight-digit label whose first four digits specify the input record number and whose second four digits specify location in the record of the first character in the line, is typeset in the margin opposite each line. The output is proof read, and corrections are keyboarded. The original input file and the corrections are processed through a file maintenance program. The output tape of this program is now ready for processing through the Linotron System in the final mode.

Master typography program

The master typography program must determine the placement dimensions, point size, and typeface of each character to be typeset in accordance with the design specifications contained in the parameter area. Performing this task is more analogous to the making of a drawing than it is to line printing. After making up the page in core, the program must output the data on the tape that will be used as input to the photocomposer. The master typography program and the instructions for its use have been written so as to make the Linotron system (the phototypesetter and master typography program) look like an off-line printer to data processing personnel in the field.

The master typography program has been written for an IBM 360 Mod 40 computer. A brief description of the major sections of the program follows:

Input: The Input Section can handle record lengths up to 3,000 characters. Either seven-channel or nine-channel tapes can be read-in. The input code can be any specified bit configuration of a six-, seven-, or eight-level code. *Initialization:* In the initialization section, function codes are detected and analyzed. The pertinent parameters are located and the routing for the data that follows is set up. *Translation:* The translation section provides for translation of input character codes to output character codes. Character widths are also looked up in this section. *Line composition:* The data are arranged into lines in the line composition section. Most lines fall into one of the following four categories: 1 justified (even margins), 2 quad left (uneven right edge), 3 quad right (uneven left edge), 4 centered. A number of auxiliary routines are required by the line composition section. *Hyphenation:* The hyphenation routine is needed for packing of type. The routine in this program is based on rules of syllabification and contains no exception dictionary. It is very accurate. *Zero suppress:* As with the line printer, a routine is required to suppress printing of zeros preceding the number in a column table. *Underscore:* The Linotron can generate straight lines horizontally. The underscore routine makes possible the underlining of any specified word, group of words, or line. *Quad space:* This routine is for extra space between word groups. The amount of space and its relative position must be contained on input. *Proof line identification:* When Linotron is operated in the proof mode, a cross-reference number is typeset alongside each line. *Revision flag:* If the input data contains a code indicating relative position of beginning and end of a revision, the master typography program generates a star or other specified character to be typeset at the beginning of each paragraph in the revision. *Point size change:* This is for where it is necessary to set one or more words in a line in a different point size from that of the remainder of the line. *Matrix:* For the setting of alphanumeric data in a constant width (matrix) form. *Word break:* Where strings of words not separated by wordspaces may occur this routine operates with other characters that can be used to separate words in making up the line. *Page composition:* Once the line is composed, it must be positioned on the page in accordance with the format specifications. As in the case of line composition, many auxiliary routines are required by this section. *Column justification:* The columns on a multicolumn page must be made equal in length in accordance with logic contained in this section. *Graphic insertion:* The master typography program provides for the inserting of illustrations within text in accordance with a specified set of rules. These rules provide for good packing density and a pleasing arrangement of illustrations. *Footnote insertion:* This is to set footnotes. *Headings insertion:* For different types of headings. *Proof setting:* This is for proofing. *Frame advance:* Produces instructions for an automatic error check and advance of the film in magazine. *Output section:*

This section provides for packing the data into records of 2,048 characters and writing them out on tape. The large number of routines contained in the program, with the method by which the typographic parameters are utilized, produces a wide range of tabular and textual formats from computer generated and keyboarded input. The rules for preparation of a new format must be followed closely.

Format preparation

The format specifications stored in the parameter area of the master typography program route input data. Proper preparation of the format specifications is essential to successful production. The steps required to prepare a new format are: 1 Design the page and typeset a dummy, 2 Define any overlay headings required, 3 Break the data into field or data elements, 4 Specify in detail the input, 5 Prepare specifications for the formatting of each data element or field, 6 Specify the page descriptors which facilitate page makeup, 7 Determine the character complement and specify the character grids required, 8 Add the new format to the parameter tape.

A set of forms entitled *Format Specification Coding* records the first seven steps. The completed forms facilitate the preparation of the parameter tape mentioned in step 8.

Page design: The typographer requires examples of the data to be printed, some idea of the intention of the publication and of the relationship of the report with others in the same system. This is crucial because it is here that decisions affecting economy and readability are made. Dummy pages are typeset conventionally. After approval is received specification preparation can proceed.

Overlay headings: When a portion of a page is often repeated on succeeding pages, it is possible to handle it as overlay heading, for example for line rules and column headings of a table. The Linotron phototypesetter contains a slide projector. A slide containing the overlay heading is inserted in the projector magazine. When the codes on the input tape call for it, the heading on the slide is projected on to the output. The slide number and type of page (odd, even) must be entered on the appropriate format specification coding form to output the slide project codes at the beginning of the specified frames (pages).

Data element definition: Any format is made up of data elements that have identical spatial and typographic characteristics. Chapter titles, main headings, sub headings, text, footnotes, and data in a given column of a table are all examples of data elements. A locator is defined as a tag code inserted at the beginning of data elements. It is easiest to determine the like elements of data by marking up the typeset dummy of the format.

Input specification: The input code is as simple as possible, but it is necessary to have a minimum number of function codes in input. Some of the more important ones are:

Shift: data following are upper case. Unshift: data following are lower case. Format: format change. It is followed by format number (four digits). Locator: identifies each data element. End of paragraph: ends a line within a data element. Typeface: permits typographic changes within a data element.

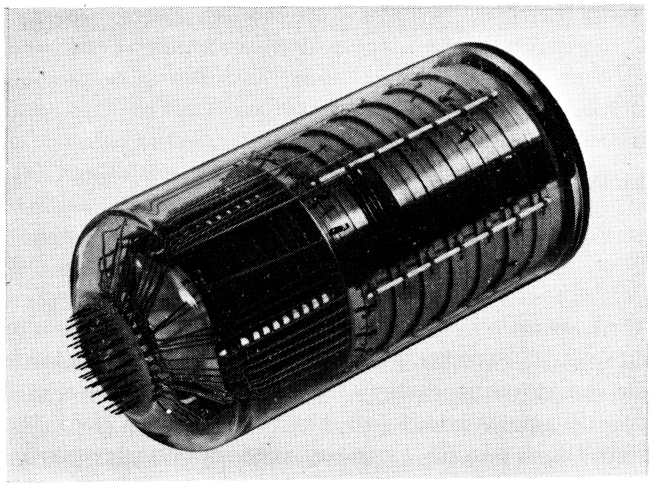

Fig 3 Linotron D (tube)

Data element specifications: Since data elements tagged by a locator have identical characteristics, it is possible to store these characteristics for each data element on the parameter tape. The parameters, used to specify a data element format, can be classified as dimensional or typographic. Examples of dimensional parameters are: point size, line length, primary indent, word space—minimum, word space—maximum, and origin 'Y' first line of page. Examples of typographic parameters are: typeface, grid, heading type, column split permissible?

Page descriptors: The master typography program also provides for page composition where it is necessary to provide makeup information independent of input. This information is called 'page descriptor data', and is also entered into the master typography program from the parameter tape. As with data elements, the page descriptor parameters are classified as dimensional and typographic. Examples of dimensional page descriptors are: column origin, column width, column length and column justification tolerance. Examples of typographic parameters are: page orientation (normal or turn), column count and folio separation character.

Character complement: This should be determined by the typographer. The grids containing these characters are selected and the grid identification numbers are entered on the format specification coding form. It is important to keep the most frequently used characters on one grid because time is lost by frequent grid changes. In fact, there may be cases where a special grid should be ordered. A system for incorporating into a grid library tape the width tables for each new grid produced has been developed.

Parameter tape preparation: The format design specification coding forms are completed by performance of the first seven steps of format design. The data are keypunched into parameter cards. These, together with the grid library tape and the original parameter library tape, are processed in the computer programmed with the parameter maintenance program.